

EXHIBIT C

Oracle USA, Inc., et al.

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Plaintiffs,

)

v.

) Case No. 07-CV-01658 PJH (EDL)

)

SAP AG, et al.

)

Defendants.

)

EXPERT REPORT OF DANIEL S. LEVY, Ph.D.

November 16, 2009

Confidential

of the Retrofit population and Critical Support population of Fixes. The Retrofit Fix sample size is 46 Fixes out of a total population of 212 Fixes. The Critical Support sample size is 238 Fixes out of a population of 973 Fixes. I use standard statistical formulas to extrapolate results from the sample to the entire population of Fixes. Later in this report, I will discuss the construction of the sample, the use of sampling to learn information about a wider population, and the extrapolation of results. I will also provide details about the measures for which Mr. Mandia gathered information. Oracle is interested in capturing SAP TN's activity as it related to the use of Objects⁴ and Environments.⁵ In this executive summary, I highlight some of the measures that address these particular topics.

One piece of information collected for the samples of Retrofit and Critical Support Fixes was the number of customers that received a Fix as a First or Identified Deliverable.⁶ Using the

⁴ Based on conversations with Mr. Mandia, I understand an Object to mean, with respect to the PeopleSoft product family, a File-based Object, a DAT file, or a DMS file. A File-based Object refers to PeopleSoft COBOL (Common Business-Oriented Language, a programming language with its primary domain in business, finance, and administrative systems for companies and governments) source code files, SQR (Structured Query Reporter, a programming language designed for generating reports from database management systems) files, and SQC (Structured Query Language Common Code) files. A DAT file is a data file or a file with a .dat extension. A DMS file is a Data Mover Script file. I understand there might be additional Object types not included in this analysis.

⁵ Based on conversations with Mr. Mandia, it is my understanding that an Environment is the combination of an installation or copy on SAP TN systems of Oracle Enterprise Application Software and a corresponding database. I further understand from Mr. Mandia that SAP TN used Environments as a crucial tool in its creation of Fixes in both the Retrofit and Critical Support Models.

⁶ Based on conversations with Mr. Mandia, it is my understanding that a First Deliverable is one or more Objects (typically, a compressed file) received by an SAP TN customer, as indicated on Delivered Updates and Fixes. A First Deliverable is a combination of a customer and a Fix because it is the first time a customer received a particular Fix. An Identified Deliverable is an occurrence in which an SAP TN customer received a Fix, as indicated in the SAS database.

Based on conversations with Mr. Mandia, it is my understanding that Delivered Updates and Fixes refers to the unique set of PeopleSoft HRMS Fixes that were delivered to SAP TN customers based on Mr. Mandia's analysis of three sources: TN Hard Drive 78, TN Disc 09, and TN Disc 186.

sample of Retrofit Fixes, I find that on average, 7.13 customers received each Retrofit Fix as a First or Identified Deliverable.⁷ Using this average, I estimate that the total number of instances in which customers received a First or Identified Deliverable in the Retrofit population is 1,511.⁸ Using the sample of Critical Support Fixes, I find that on average, 26.79 customers received a Critical Support Fix as a First or Identified Deliverable.⁹ Using this average, I estimate that that total number of instances in which customers received a First or Identified deliverable in the Critical Support population is 26,070.¹⁰

For each Fix in the Retrofit and Critical Support samples, Mr. Mandia also counted the number of Objects comprising First Deliverables or Identified Deliverables, and the number of copies of those Objects.¹¹ Such Objects are termed Associated Files.¹² Using the sample of Retrofit Fixes, I find that on average, there are 237.02 Associated Files for a Retrofit

Based on conversations with Mr. Mandia, it is my understanding that SAP TN used the SAS database to manage its relationships with customers, for instance by tracking information such as the relevant software version for the client and the point of contact at the client.

⁷ Based on my results the 90% confidence interval ranges from 5.79 to 8.46. This means that in repeated samples the true value in the population has a 90% chance of falling within the confidence intervals constructed in this way from the sample. Confidence intervals are discussed in the body of this report on page 10.

⁸ The 90% confidence interval for this measure ranges from 1,228 to 1,794.

⁹ Based on my results the 90% confidence interval ranges from 26.78 to 26.81.

¹⁰ The 90% confidence interval for the Critical Support population ranges from 26,057 to 26,084.

¹¹ Based on conversations with Mr. Mandia, it is my understanding that the total number of copies of Objects here includes Objects delivered to customers as well as any additional copies of those Objects found or recorded on SAP TN's systems for that Fix. Objects included in compressed files are counted as copies.

¹² Based on conversations with Mr. Mandia, it is my understanding that Fixes were sometimes grouped together for delivery in "bundles." If two Fixes that affected the same Object were delivered to the same customer in the same bundle, only one Object would be delivered to that customer; however, the customer would have received two Associated Files, one for each Fix.

Fix.^{13,14} Based on this sample the total number of copies of Associated Files for Retrofit Fixes is estimated to be 50,247.¹⁵ Similarly, I find that on average, there are 655.10 copies of Objects associated with First or Identified Deliverables of a Critical Support Fix.¹⁶ For the Critical Support population, I estimate that there were 637,412 copies of Associated Files for Critical Support Fixes.¹⁷

For each Fix in the Retrofit and Critical Support samples, Mr. Mandia also counted the number of Environments used in the development or testing of that Fix. Using the sample of Retrofit Fixes, I find that on average, SAP TN used 2.63 Environments in the development or testing of a Retrofit Fix.¹⁸ Based on this sample the total number of Environments used by SAP TN for Retrofit Fixes is estimated to be 558.¹⁹ Similarly, I find that on average, SAP TN used 6.35 Environments to develop or test Critical Support Fixes.²⁰ For the Critical Support population, I estimate that 6,177 Environments were used by SAP TN in the development and testing of Critical Support Fixes.²¹

¹³ Based on conversations with Mr. Mandia, it is my understanding that an Associated File is a COBOL, SQR, SQC, DAT, or DMS file that is associated with the development, testing or delivery of a Fix.

¹⁴ Based on my results the 90% confidence interval ranges from 232.62 to 241.41.

¹⁵ The 90% confidence interval ranges from 49,315 to 51,180 for the population of Retrofit Fixes.

¹⁶ The 90% confidence interval ranges from 655.06 to 655.14.

¹⁷ The 90% confidence interval for the total for Critical Support Fixes ranges from 637,370 to 637,454.

¹⁸ Based on my results the 90% confidence interval ranges from 2.30 to 2.96.

¹⁹ The 90% confidence interval ranges from 488 to 628 in the population of Retrofit Fixes.

²⁰ The 90% confidence interval ranges from 5.92 to 6.77.

²¹ The 90% confidence interval ranges from 5,763 to 6,592.

Mr. Mandia also gathered information to understand Contamination²² of Objects and Environments. One measure to capture this information, which was counted for the entire population of Fixes for Retrofit and for Critical Support, is the percentage of instances in which customers received a First Deliverable that was contaminated based on Mr. Mandia's analysis of Objects. For Retrofit Fixes, 89.75% of the time that customers received a First Deliverable, that deliverable was contaminated based on Mr. Mandia's analysis of Objects found in Delivered Updates and Fixes. This same measure for Critical Support Fixes shows that 93.72% of the time, customers received a First Deliverable that was contaminated based on Mr. Mandia's analysis of Objects found in Delivered Updates and Fixes.

A second measure of Contamination is provided by the percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on either Object analysis or on analysis of SAP TN's development and testing documentation. Based on my analysis of the Retrofit sample, 83.92% of the instances in which customers received First or Identified Deliverables were contaminated, based on Mr. Mandia's Object and documentation analysis.²³ This same measure for Critical Support shows that 99.12% of the instances in which customers received First or Identified Deliverables were contaminated, based on Mr. Mandia's Object and documentation analysis.²⁴

Another measure of Contamination is provided by the percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on Object and documentation analysis or based on the fact that the

²² Based on conversations with Mr. Mandia, it is my understanding that a Fix is Contaminated if Cross-Use of any software occurred at any point in the development, testing, or production of any Object for that Fix. Cross-Use means a use of an Environment licensed to one customer to provide support to another customer.

²³ The 90% confidence interval ranges from 71.56% to 96.29% in the population of Retrofit Fixes.

²⁴ The 90% confidence interval ranges from 98.65% to 99.52% in the population of Critical Support Fixes.

customer's Environment was used to support other customers. My analysis of the Retrofit sample shows that 87.19% of the instances in which customers received First or Identified Deliverables were contaminated, based on Mr. Mandia's Object and documentation analysis and his analysis of the customer's Environment.²⁵ This same measure for Critical Support shows that 99.19% of the instances in which customers received First or Identified Deliverables were contaminated, based on Mr. Mandia's Object and documentation analysis and his analysis of the customer's Environment.²⁶

A fourth measure of Contamination is captured by the percentage of hashes for the set of COBOL, SQR, SQC or DAT Associated Files in any First Deliverable that were contaminated based on Object analysis. The components of this measure were counted for the full population of Retrofit and Critical Support Fixes. My analysis of the Retrofit population shows that 87.66% of hashes for the set of COBOL, SQR, SQC or DAT Associated Files in any First Deliverable were contaminated based on Object analysis. This same measure for Critical Support shows 67.96% of hashes for the set of COBOL, SQR, SQC or DAT Associated Files in any First Deliverable were contaminated based on Object analysis.

A final measure of Contamination is captured by the percentage of hashes for the set of DAT Associated Files in any First Deliverable that were contaminated based on Object analysis. The components of this measure were counted for the full population of Retrofit and Critical Support Fixes. My analysis of the Retrofit population shows that 89.29% of hashes for the set of DAT Associated Files in any First Deliverable were contaminated based on Object analysis. This same measure for Critical Support shows 82.59% of hashes for the set of DAT Associated Files in any First Deliverable were contaminated based on Object analysis.

²⁵ The 90% confidence interval ranges from 74.64% to 99.74% in the population of Retrofit Fixes.

²⁶ The 90% confidence interval in the Critical Support Fix population ranges from 98.73% to 99.57%.

information for many of these measures can be gathered for the entire population of Retrofit and Critical Support Fixes to demonstrate the extent of SAP TN's activity. For example, the number of COBOL, SQR, and SQC files used in the delivery of Fixes can be calculated for all Fixes by a computer forensics expert. However, because of the lack of clear documentation, the lack of systematic record-keeping by SAP TN, the technical difficulty in gathering the information required for many of these measures, and therefore the enormous increase in the amount of time and effort that would be required to gather data for many of the other measures of interest, Mr. Mandia has collected information for some aspects of Retrofit Fixes and Critical Support Fixes based on a scientific, random sample of the Retrofit and Critical Support population of Fixes.²⁹ These data are used to estimate the value of measures of interest in the population of Retrofit Fixes and the population of Critical Support Fixes.

The statistical techniques and calculations that I use in this report to generate results have been chosen because they are well-tested, generally known and accepted, and well-documented in standard statistical textbooks. I have selected specific statistical methods for each type of measure investigated by Mr. Mandia to provide accurate estimates of measures that are of interest in detecting Contamination. The selection of statistical methods is not driven by any legal facts or conclusions. These are standard, well-known formulas that are used in sampling situations.

7) Sampling

a. General Description

Sampling is used in many different scientific disciplines – biology, chemistry, economics and sociology to name a few – to make statements about a measure of interest for a population, when it may be too expensive, difficult, or time-consuming to collect information about that measure of interest for the entire population. Sampling offers some advantages, such as the ability to gather information at a lower cost and with greater speed. In many instances,

²⁹ In conversations with me, Mr. Mandia thought that it would require thousands of hours of time by highly-trained computer forensic staff to capture data for some groups of measures across the entire population of Fixes.

If her random number generator would have produced a different set of 50 floors, her sample average and the extrapolated total could have been different. The likely difference would depend on the sample size she has chosen and the variation in the number of computers on each floor. Using the data she has, she can estimate that likely variation, with a calculation known as the standard error, which measures the average variation in her sample. If the standard error in the sample is large, her estimate of the number of computers on each floor will be less precise than if the standard error in her sample were smaller.³² Once that standard error of the sample is determined, it can be used to calculate and report an upper and lower bound for the estimated average number of computers on each floor and the total number of computers on all 600 floors of the office buildings in the population. At the 90% confidence level, the upper bound for this total is 25,711 and the lower bound is 20,489. This is equivalent to saying that if she were to take repeated scientific random samples of 50 floors, there is a 90% chance that the true value of the total number of computers on those 600 floors is between the confidence bounds calculated for each of those samples, in this sample 20,489 and 25,711. If the researcher required an estimate of the number of computers in the buildings plus or minus 1000 or even 200, she could achieve that by increasing the sample size.

b. Protocol

The issues in this matter provide a compelling reason to use sampling because the kind of information necessary for determining the extent of infringement by SAP TN is extremely difficult to gather for some measures of interest, in terms of both time and cost of collecting the data.³³ The required degree of precision for estimating these measures can be achieved through a sample. The unit of measure is a Fix, as defined by Oracle's computer forensics expert, Mr. Mandia. Internally, SAP TN distinguished between its Retrofit Support process

³² The statistician has no influence over the standard error found in a sample of a given size. The standard error of the sample is simply a characteristic of the sample she has drawn that reflects the variability in the sample of a given size.

³³ In conversations with me, Mr. Mandia thought that it would require thousands of hours of time by highly trained computer forensic staff to capture data for some groups of measures across the entire population of Fixes.

TABLE 5: UNION MEASURES

Measure	
	Total number of environments used in development or testing of fixes (SAS, Delivered Updates and Fixes, Consultant Docs and Templates)
117	(Union 115,116)
	Total number of instances in which customers received a contaminated First or Identified Deliverable based on analysis of objects and of development and testing documentation
128	(Union 122,123,124,125)
	Total number of instances in which customers received a contaminated fix based on object and documentation analysis, when cross-use of a customer-specific environment renders activities on behalf of the customers infringing (Analysis)
129	(Union 122, 123, 124, 125, 126)

3. Measures 120 and 134 are each composed of two measures, and therefore I call them composite measures. Measure 120 is composed of component measures 118 and 119. Measure 134 is composed of component measures 114 and 133. For both measures 120 and 134, one component of the measure is recorded for the entire population and the other component is reported for the sample. For measures 120 and 134, since one of the components is measured for the full population, the only source of variance is the component that is measured only in the sample. Therefore, for measure 120, the only source of variance is measure 119, and for measure 134, the only source of variance is measure 114. Table 6 lists these measures and I present the related formulas in *Appendix 1*.

TABLE 6: MEASURES THAT ARE SUMS OF OTHER MEASURES

Measure	
	Total number of instances in which customers received a First Deliverable or Identified Deliverable (Delivered Updates and Fixes, SAS)
120	(118+119)
	Total number of copies of objects comprising First or Identified Deliverables (including copies located in compressed files) (Delivered Updates and Fixes, Data Warehouse, Environment Backup, BakTrak, SAS)
134	(133+114)

4. For two measures, measures 131 and 132, I use a ratio estimator to estimate their population means and population variances. The ratio estimator can be used to report

population totals, means or ratios, such as in measures 131 and 132.⁴⁰ Table 7 lists these two measures and I discuss the related formulas in *Appendix 1*.

TABLE 7: MEASURES ESTIMATED WITH THE RATIO ESTIMATOR

Measure	
	Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object and documentation analysis (Analysis)
131	(128/120)
	Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object or documentation analysis or on the fact that the customer's environment was used to support other customers (Analysis)
132	(129/120)

9) Results

In this section, I discuss the results of the population counts as well as the various extrapolation methods described in the section above. The tables below are presented in groups of measures that conceptually belong together. This grouping has been provided by Mr. Mandia.

Tables 8A and 8B show the results for measures related to numbers of versions affected by SAP TN's activities. Measure 101 is measured for the full population and therefore does not have any reported standard deviation or confidence interval. Measure 102 is measured only for the samples for each type of Fix. Table 8A illustrates that based on this sample the 90% confidence interval for the true value for the total number of Retrofit Fixes for distinct versions ranges from 330 to 463. This means that in repeated samples the true value in the population has a 90% chance of falling within the confidence intervals constructed in this way from the sample.

⁴⁰ The ratio estimator is often used for estimating ratios in the population. See William G. Cochran, *Sampling Techniques*, Third Edition (New York: Wiley & Sons, 1977) 30-31.

TABLE 8A: VERSION MEASURES FOR RETROFIT**Retrofit****Sample Size: 46****Population Size: 212****Confidence Level: 90%**

Measure		Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
101	Total number of fixes for distinct versions, according to the Application Release field in SAS (SAS)		245				1.16		
	Total number of fixes for distinct versions, based on the versions supported by SAP TN for customers (SAS, Delivered Updates and Fixes)	330	396	463	40	1.56	1.87	2.18	0.19

TABLE 8B: VERSION MEASURES FOR CRITICAL SUPPORT**Critical Support****Sample Size: 238****Population Size: 973****Confidence Level: 90%**

Measure		Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
101	Total number of fixes for distinct versions, according to the Application Release field in SAS (SAS)		712				0.73		
	Total number of fixes for distinct versions, based on the versions supported by SAP TN for customers (SAS, Delivered Updates and Fixes)	4,817	5,213	5,608	240	4.95	5.36	5.76	0.25

Tables 9A and 9B show the results for measures that record information based on analysis of hashes for COBOL, SQR, SQC, DAT or DMS files. Measures 104, 105, 106, 142, and 143 are measured for the full population and therefore their respective results do not need confidence intervals because they are reported with full certainty. The results for measures 139, 140, and 141, on the other hand, are reported based on extrapolation from the samples and therefore are presented with confidence intervals. Table 9A shows that there were 2,228 total numbers of hashes for COBOL, SQR, SQC, DAT or DMS Associated Files that were modified for, or included in, First Deliverables for the population of Retrofit Fixes. Table 9B shows that there were 10,245 total number of hashes for COBOL, SQR, SQC, DAT or DMS Associated Files that were modified for or included in First Deliverables for the population of Retrofit Fixes.

TABLE 9A: HASH-RELATED MEASURES FOR RETROFIT**Retrofit****Sample Size: 46****Population Size: 212****Confidence Level: 90%**

		Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
Measure									
104	Total number of hashes for COBOL, SQR, or SQC Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		1,746				8.24		
105	Total number of hashes for DAT or DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes) (142+143)		482				2.27		
106	Total number of hashes for COBOL, SQR, SQC, DAT, or DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes) (104+105)		2,228				10.51		
139	Total number of unique hashes for the set of COBOL, SQR or SQC Associated Files in Identified Deliverables (SAS)	368	903	1,439	325	1.74	4.26	6.79	1.53
140	Total number of unique hashes for the set of DAT or DMS Associated Files in Identified Deliverables (SAS)	203	396	590	118	0.96	1.87	2.78	0.56
141	Total number of unique hashes for the set of COBOL, SQR, SQC, DAT or DMS Associated Files in Identified Deliverables (SAS) (139+140)	586	1,300	2,013	434	2.77	6.13	9.49	2.05
142	Total number of hashes for DAT Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		224				1.06		
143	Total number of hashes for DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		258				1.22		

TABLE 9B: HASH-RELATED MEASURES FOR CRITICAL SUPPORT**Critical Support****Sample Size: 238****Population Size: 973****Confidence Level: 90%**

		Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
Measure									
104	Total number of hashes for COBOL, SQR, or SQC Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		3,904				4.01		
105	Total number of hashes for DAT or DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes) (142+143)		6,341				6.52		
106	Total number of hashes for COBOL, SQR, SQC, DAT, or DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes) (104+105)		10,245				10.53		
139	Total number of unique hashes for the set of COBOL, SQR or SQC Associated Files in Identified Deliverables (SAS)	11	37	63	16	0.01	0.04	0.06	0.02
140	Total number of unique hashes for the set of DAT or DMS Associated Files in Identified Deliverables* (SAS)	0	8	25		0.00	0.01	0.03	
141	Total number of unique hashes for the set of COBOL, SQR, SQC, DAT or DMS Associated Files in Identified Deliverables (SAS) (139+140)	16	45	74	18	0.02	0.05	0.08	0.02
142	Total number of hashes for DAT Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		3,618				3.72		
143	Total number of hashes for DMS Associated Files that were modified for or included in First Deliverables (Delivered Updates and Fixes)		2,723				2.80		

* The lower and upper bounds are calculated using 10,000 iterations of repeated sampling. The confidence interval is directly computed. Therefore the standard error is not computed. See B. Efron & R.J. Tibshirani, *An Introduction to the Bootstrap*, (Chapman & Hall: 1993), 168-176.

Tables 10A and 10B show the results for measures that record information for Objects impacted by SAP TN's activities. Many of these measures are counted for the full population and therefore their results do not need confidence intervals because they are reported with full certainty. Measure 134 is reported for the samples of Retrofit and Critical Support Fixes and, as described in the preceding section, is a composite measure. Additionally, the results presented in Tables 10A and 10B take into account the fact that measure 133 (component measure for measure 134) is counted for the entire population of Fixes.⁴¹ Table 10A shows that the estimated total number of copies of Objects comprising First or Identified Deliverables (including copies located in compressed files) is 50,247 for Retrofit Fixes. The 90% confidence interval ranges from 49,315 to 51,180. This means that in repeated samples the true value in the population has a 90% chance of falling within the confidence intervals constructed in this way from the sample. Similarly, Table 10B shows that the estimated total number of copies of Objects comprising First or Identified Deliverables (including copies located in compressed files) is 637,412 for Critical Support Fixes. The 90% confidence interval ranges from 637,370 to 637,454. This means that in repeated samples, the true value in the population has a 90% chance of falling within the confidence intervals constructed in this way from the sample.

⁴¹ In *Appendix 2*, I present the results for these measures based on extrapolating them from the sample. See Tables A.2 and A.3.

TABLE 10A: OBJECT-RELATED MEASURES FOR RETROFIT

Retrofit
Sample Size: 46
Population Size: 212
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
107 Total number of hashes for COBOL, SQR, SQC, DAT or DMS Associated Files in any First Deliverable that were not in any Subsequent Deliverable (Delivered Updates and Fixes)		517				2.44		
108 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files found in First Deliverables for customers (Delivered Updates and Fixes)		5,128				24.19		
109 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files in duplicate copies of each customer's First Deliverable found on Delivered Updates and Fixes (Delivered Updates and Fixes)		12,628				59.57		
110 Total number of duplicate copies of the COBOL, SQR, SQC, DAT or DMS Associated Files, enumerated in measure 107, found in the Data Warehouse (other than in environment backups) (Data Warehouse)		9,137				43.10		
111 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files in duplicate copies of each customer's First Deliverable, found in the Data Warehouse (other than in environment backups) (Data Warehouse)		5,644				26.62		
112 Total number of duplicate copies of the COBOL, SQR, SQC, DAT or DMS Associated Files, enumerated in measure 107, found in environment backups (Environment Backups)		16,041				75.67		
113 Total number of duplicate copies of the COBOL, SQR and SQC Associated Files recorded by a Baktrak entry where the associated backup is not present in the Data Warehouse (BakTrak)		38				0.18		
114 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files attached to SAS records (SAS)	699	1,631	2,564	567	3.30	7.70	12.09	2.67
133 Total number of copies of objects comprising First Deliverables (including copies located in compressed files) (Delivered Updates and Fixes, Data Warehouse, Environment Backup, BakTrak) (108+109+110+111+112+113)		48,616				229.32		
134 Total number of copies of objects comprising First or Identified Deliverables (including copies located in compressed files)* (Delivered Updates and Fixes, Data Warehouse, Environment Backup, BakTrak, SAS) (133+114)	49,315	50,247	51,180	567	232.62	237.02	241.41	2.67

* This measure is reported by taking into account that one of its components is known in the full population.

TABLE 10B: OBJECT-RELATED MEASURES FOR CRITICAL SUPPORT

Critical Support
Sample Size: 238
Population Size: 973
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
107 Total number of hashes for COBOL, SQR, SQC, DAT or DMS Associated Files in any First Deliverable that were not in any Subsequent Deliverable (Delivered Updates and Fixes)		9,433				9.69		
108 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files found in First Deliverables for customers (Delivered Updates and Fixes)		54,548				56.06		
109 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files in duplicate copies of each customer's First Deliverable found on Delivered Updates and Fixes (Delivered Updates and Fixes)		69,986				71.93		
110 Total number of duplicate copies of the COBOL, SQR, SQC, DAT or DMS Associated Files, enumerated in measure 107, found in the Data Warehouse (other than in environment backups) (Data Warehouse)		149,655				153.81		
111 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files in duplicate copies of each customer's First Deliverable, found in the Data Warehouse (other than in environment backups) (Data Warehouse)		71,785				73.78		
112 Total number of duplicate copies of the COBOL, SQR, SQC, DAT or DMS Associated Files, enumerated in measure 107, found in environment backups (Environment Backups)		274,349				281.96		
113 Total number of duplicate copies of the COBOL, SQR and SQC Associated Files recorded by a Baktrak entry where the associated backup is not present in the Data Warehouse (BakTrak)		17,024				17.50		
114 Total number of COBOL, SQR, SQC, DAT or DMS Associated Files attached to SAS records (SAS)	23	65	107	26	0.02	0.07	0.11	0.03
133 Total number of copies of objects comprising First Deliverables (including copies located in compressed files) (Delivered Updates and Fixes, Data Warehouse, Environment Backup, BakTrak)		637,347				655.03		
134 (133+114) Total number of copies of objects comprising First or Identified Deliverables (including copies located in compressed files)* (Delivered Updates and Fixes, Data Warehouse, Environment Backup, BakTrak, SAS)	637,370	637,412	637,454	26	655.06	655.10	655.14	0.03

* This measure is reported by taking into account that one of its components is known in the full population

Tables 11A and 11B present results for measures that record information for Environments affected by the Fixes distributed by SAP TN. Measure 115 is reported for the full population, and therefore its results are reported with full certainty and do not require confidence intervals. Measure 117 is reported for the samples of Retrofit and Critical Support Fixes and, as described in the preceding section, is a composite measure. The results

presented in Tables 11A and 11B take into account the fact that measure 115 (component measure for measure 117) is counted for the entire population of Fixes.⁴²

TABLE 11A: ENVIRONMENT-RELATED MEASURES FOR RETROFIT

Retrofit
Sample Size: 46
Population Size: 212
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
115 Total number of environments used in development or testing of fixes, as identified in DAT Associated Files in a First Deliverable (Delivered Updates and Fixes)		97				0.46		
116 Total number of environments used in development or testing of fixes, as identified in development, test and other documentation (SAS, Consultant Docs and Templates)	432	512	591	48	2.04	2.41	2.79	0.23
117 Total number of environments used in development or testing of fixes* (SAS, Delivered Updates and Fixes, Consultant Docs and Templates) (Union 115,116)	488	558	628	43	2.30	2.63	2.96	0.20

* This measure is reported by taking into account that one of its components is known in the full population.

TABLE 11B: ENVIRONMENT-RELATED MEASURES FOR CRITICAL SUPPORT

Critical Support
Sample Size: 238
Population Size: 973
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
115 Total number of environments used in development or testing of fixes, as identified in DAT Associated Files in a First Deliverable (Delivered Updates and Fixes)		2,412				2.48		
116 Total number of environments used in development or testing of fixes, as identified in development, test and other documentation (SAS, Consultant Docs and Templates)	3,447	3,867	4,288	255	3.54	3.97	4.41	0.26
117 Total number of environments used in development or testing of fixes* (SAS, Delivered Updates and Fixes, Consultant Docs and Templates) (Union 115,116)	5,763	6,177	6,592	252	5.92	6.35	6.77	0.26

* This measure is reported by taking into account that one of its components is known in the full population.

Tables 12A and 12B present results for measures that record the number of instances in which customers received First or Identified Deliverables. Measures 118 and 121 are reported for the full population. Therefore, results for measures 118 and 121 are reported

⁴² In *Appendix 2*, I present the results for this measure based on extrapolating them from the sample. See Tables A.2 and A.3.

with full certainty and do not require confidence intervals. Measures 119 and 120 are reported for the samples of Retrofit and Critical Support Fixes. Measure 119 is extrapolated using a mean per unit estimator as described in the previous section. Measure 120 is a composite measure because it is the sum of two measures. Additionally, one of its components (118) is measured for the full population.

TABLE 12A: CUSTOMER-RELATED MEASURES FOR RETROFIT**Retrofit****Sample Size: 46****Population Size: 212****Confidence Level: 90%**

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
118 Total number of instances in which customers received a First Deliverable (Delivered Updates and Fixes)		907				4.28		
119 Total number of instances in which customers who did not receive a First Deliverable received an Identified Deliverable (SAS)	321	604	887	172	1.51	2.85	4.18	0.81
120 Total number of instances in which customers received a First Deliverable or Identified Deliverable* (Delivered Updates and Fixes, SAS) (118+119)	1,228	1,511	1,794	172	5.79	7.13	8.46	0.81
121 Total number of First Deliverables containing documentation referencing fix IDs (Delivered Updates and Fixes)		583				2.75		

* This measure is reported by taking into account that one of its components is known in the full population.

TABLE 12B: CUSTOMER-RELATED MEASURES FOR CRITICAL SUPPORT**Critical Support****Sample Size: 238****Population Size: 973****Confidence Level: 90%**

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
118 Total number of instances in which customers received a First Deliverable (Delivered Updates and Fixes)		26,054				26.78		
119 Total number of instances in which customers who did not receive a First Deliverable received an Identified Deliverable (SAS)	3	16	30	8	0.00	0.02	0.03	0.01
120 Total number of instances in which customers received a First Deliverable or Identified Deliverable* (Delivered Updates and Fixes, SAS) (118+119)	26,057	26,070	26,084	8	26.78	26.79	26.81	0.01
121 Total number of First Deliverables containing documentation referencing fix IDs (Delivered Updates and Fixes)		26,931				27.68		

* This measure is reported by taking into account that one of its components is known in the full population. Rounding in the average.

Tables 13A and 13B show some measures that address the issue of Contamination.

Measures 122 and 125 are counted for the full population, and therefore are reported with full

certainty. Measures 123, 124, and 126 are recorded for the sample. They are reported with 90% confidence intervals.

TABLE 13A: CONTAMINATION-RELATED MEASURES FOR RETROFIT

Retrofit
Sample Size: 46
Population Size: 212
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
122 Total number of instances in which customers received a First Deliverable contaminated through receipt of a DAT file not specifically generated for those customers (Analysis)		256				1.21		
123 Total number of instances in which customers received a First or Identified Deliverable contaminated by use of a generic environment, of some other customer's environment, or of an environment built from another customer's software (Analysis)	947	1,350	1,754	245	4.47	6.37	8.27	1.16
124 Total number of instances in which customers received a First or Identified Deliverable contaminated by development using the source group model* (Analysis)	0	0	0	0	0.00	0.00	0.00	0.00
125 Total number of instances in which customers received a First Deliverable contaminated because another customer received at least one COBOL, SQR, SQC or DAT Associated File with an identical hash value (Analysis)		723				3.41		
126 Total number of instances in which customers received a First or Identified Deliverable other than from an environment built solely from their software and used solely for them (Analysis)	982	1,387	1,793	247	4.63	6.54	8.46	1.16

*Measure 124 was zero in all 46 observations of the Retrofit sample files, which makes the calculation of an upper bound for this measure less pertinent. A conservative estimate of the upper bound, using formulas from classical sampling theory, is zero. There are further refinements available, such as an exact binomial test, that allow for the calculation of the probability of a observing a non-zero value in the population. Such a calculation implies that there is a 4.8% chance of observing a non-zero value, which translates to no more than 10 non-zero occurrences in the population.

TABLE 13B: CONTAMINATION-RELATED MEASURES FOR CRITICAL SUPPORT

Critical Support
Sample Size: 238
Population Size: 973
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
122 Total number of instances in which customers received a First Deliverable contaminated through receipt of a DAT file not specifically generated for those customers (Analysis)		19,899				20.45		
123 Total number of instances in which customers received a First or Identified Deliverable contaminated by use of a generic environment, of some other customer's environment, or of an environment built from another customer's software (Analysis)	20,884	23,552	26,220	1,622	21.46	24.21	26.95	1.67
124 Total number of instances in which customers received a First or Identified Deliverable contaminated by development using the source group model (Analysis)*	49	319	683		0.05	0.33	0.70	
125 Total number of instances in which customers received a First Deliverable contaminated because another customer received at least one COBOL, SQR, SQC or DAT Associated File with an identical hash value (Analysis)		23,429				24.08		
126 Total number of instances in which customers received a First or Identified Deliverable other than from an environment built solely from their software and used solely for them (Analysis)	21,901	24,660	27,420	1,678	22.51	25.34	28.18	1.72

*The lower and upper bounds are calculated using 10,000 iterations of repeated sampling. The confidence interval is directly computed. Therefore the standard error is not computed. See B. Efron & R.J. Tibshirani, An Introduction to the Bootstrap, (Chapman & Hall: 1993), 168-176.

Tables 14A and 14B show additional measures that address the issue of Contamination.

Measures 127 and 130 are all recorded for the full population, and therefore are reported with full certainty. Measures 128 and 129 are composite measures, as defined in the preceding section. Measures 130 and 131 are reported for the sample. Measures 128, 129, 131 and 132 are reported with a 90% confidence interval. Measure 131 shows that in instances in which customers received a first deliverable Retrofit Fix, 83.92% of the First Deliverables were contaminated based on Object analysis. This same measure for the Critical Support Fix population is 99.12%.

TABLE 14A: CONTAMINATION-RELATED COMPOSITE AND RATIO MEASURES FOR RETROFIT

Retrofit
Sample Size: 46
Population Size: 212
Confidence Level: 90%

Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
127 Total number of instances in which customers received a contaminated First Deliverable based on analysis of delivered objects (Analysis) (Union 122,125)		814				3.84		
128 Total number of instances in which customers received a contaminated First or Identified Deliverable based on analysis of objects and of development and testing documentation* (Analysis) (Union 122,123,124,125)	1,019	1,224	1,430	125	4.80	5.77	6.74	0.59
129 Total number of instances in which customers received a contaminated fix based on object and documentation analysis, when cross-use of a customer-specific environment renders activities on behalf of the customers infringing* (Analysis) (Union 122, 123, 124, 125, 126)	1,028	1,279	1,531	153	4.85	6.04	7.22	0.72
130 Percentage of instances in which customers received a First Deliverable where that First Deliverable was contaminated based on analysis of objects found in Delivered Updates and Fixes (Analysis) (127/118)		89.75%						
131 Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object and documentation analysis** (Analysis) (128/120)	71.56%	83.92%	96.29%	7.52%				
132 Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object or documentation analysis or on the fact that the customer's environment was used to support other customers** (Analysis) (129/120)	74.64%	87.19%	99.74%	7.63%				

* These measures are reported by taking into account that some of their components are known in the full population.

** Based on the values for the numerator and denominator in the sample of 46 fixes, as reported in Table A.2 in Appendix 3. These values are used to provide classic estimates of the standard errors. Values in Tables 12A and 14A produce a value of 81.03% for measure 131 and 64.69% for measure 132.

TABLE 14B: CONTAMINATION-RELATED COMPOSITE AND RATIO MEASURES FOR CRITICAL SUPPORT

Critical Support
Sample Size: 238
Population Size: 973
Confidence Level: 90%

	Measure	Total Lower Bound	Total	Total Upper Bound	Standard Error of Total	Average Lower Bound	Average	Average Upper Bound	Standard Error of Average
127	Total number of instances in which customers received a contaminated First Deliverable based on analysis of delivered objects (Analysis) (Union 122,125)		24,417				25.09		
128	Total number of instances in which customers received a contaminated First or Identified Deliverable based on analysis of objects and of development and testing documentation* (Union 122,123,124,125)	24,895	25,390	25,885	301	25.59	26.09	26.60	0.31
129	Total number of instances in which customers received a contaminated fix based on object and documentation analysis, when cross-use of a customer-specific environment renders activities on behalf of the customers infringing* (Analysis) (Union 122, 123, 124, 125, 126)	24,796	25,410	26,025	374	25.48	26.12	26.75	0.38
130	Percentage of instances in which customers received a First Deliverable where that First Deliverable was contaminated based on analysis of objects found in Delivered Updates and Fixes (Analysis) (127/118)		93.72%						
131	Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object and documentation analysis*** (Analysis) (128/120)	98.65%	99.12%	99.52%					
132	Percentage of instances in which customers received a First or Identified Deliverable where that First or Identified Deliverable was contaminated based on object or documentation analysis or on the fact that the customer's environment was used to support other customers*** (Analysis) (129/120)	98.73%	99.19%	99.57%					

* These measures are reported by taking into account that some of their components are known in the full population

** Based on the values for the numerator and denominator in the sample of 238 fixes, as reported in Table A.3 in Appendix 3. These values are used to provide classic estimates of the standard errors. Values in Tables 128 and 148 produce a value of 97.39% for measure 131 and 97.47% for measure 132.

* The lower and upper bounds are calculated using 10,000 iterations of repeated sampling. The confidence interval is directly computed. Therefore the standard error is not computed. See B. Efron & R.J. Tibshirani, An Introduction to the Bootstrap, (Chapman & Hall: 1993), 168-176

Tables 15A and 15B present results for measures that address Object Contamination. All these measures are counted for the entire population of Fixes. Measure 138 demonstrates that 87.66% of hashes that were associated with a First Deliverable were contaminated in the Retrofit Fix population. This same measure for the Critical Support Fix population is 67.96%.

Finance and Financial Services: Dr. Levy has worked on a number of cases involving late trading and rapid trading issues and Market Maker trading behavior brought against financial institutions by the Securities and Exchange Commission and the New York Attorney General. He has performed a wide range of event studies for securities valuations for 10B-5 disputes and for general damages. He has estimated damages associated with late and rapid trading. He has studied the appropriate use of interest rates for use in damages models. He has presented his research in Federal Court, and before Government Agencies including DOJ, NY-OAG, FCC, and SEC among others.

He is expert in numerous statistical and modeling applications, and has modeled complex economic and social factors affecting, labor, demographic and market behavior.

Prior to founding Advanced Analytical Consulting Group, Dr. Levy was the National Market Leader for Economic and Statistical Consulting for Deloitte Financial Advisory Services and had served as the Global Leader of Economic Consulting for Arthur Andersen. Prior to that he held research and consulting positions at Charles River Associates, The RAND Corporation, Needham-Harper Worldwide Advertising, SPSS Inc. and The University of Chicago Computation Center.

EXPERT TESTIMONY/AFFIDAVITS

- Drs Newco III, Inc v. Night Vision Equipment Company Holding, Inc, 2008, Expert Report, Testimony, *Damages in High Technology Market*.
- Invesco Institutional (N.A.) Inc v Deutsche Investment Management Americas, Inc, 2008, Expert Report, *Damages in Financial Services Industry*.
- Securities and Exchange Commission v. Kenneth D. Pasternak and John P. Leighton, 2007, 2008. Expert Report, Testimony, *Securities Trading and Market Making Damages*.
- Cytologix v. Ventana, 2002, 2007 Expert Report, Depositions, Testimony, *Antitrust in High Technology Medical Market*.
- Rubin Squared Inc. v. Cambrex Corporation, 2006 Case No. 03-CIV. 10138(PAC) Expert Report.

- Polaris Industries Inc. v. Commission of Revenue, 2005, Expert Report, Minnesota Tax Court, Docket No. 7694-R
- Before the New Mexico Department of Insurance, 2004, Expert Report, *Health Insurance Merger*.
- Carolyn Fears, et al. v. Wilhelmina Model Agency, Inc., et al., 2003, Expert Report and Deposition, *Antitrust Price-Fixing*.
- Shoshone and Arapaho Indian Tribes v. the United States of America, 2003, Expert Report and Deposition, *Statistical Sampling*.
- Pechiney Plastic Packaging Inc. v. Continental PET Technologies Inc. 2002, Expert Report and Deposition, 2002, *Statistical Sampling/Patent Infringement*.
- Before the Illinois Commerce Commission, 2001, Expert Report and Testimony, *Statistical Methods*.
- IRS Expert Arbitrator, 2000, James Schilling Inc., v. Internal Revenue Service, *Expert Arbitrator Report and Decision*.
- Before the Wisconsin Public Utilities Commission, 2000, Expert Report and testimony *Statistical Methods*.
- Before the New Mexico Insurance Commissioner, 1999, Expert Witness, *Hospital Merge*.
- Before the Michigan Public Service Commission, 1998, Expert Affidavit, *Statistical Analysis*.
- Statistical Methods for Parity Tests of Telecommunications Resale and Retail Markets, Before the Indiana Public Service Commission, 1998, Expert Affidavit, *Statistical Analysis*.
- Before the FCC, CC Docket No. 98-56, RM-9101, 1998, Expert Affidavit, *Statistical Analysis*.